

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT



Applicant: Honeywell International Inc.
9680 Old Bailes Rd, Fort Mill, SC 29707, USA
Manufacturer: Honeywell International Inc.
9680 Old Bailes Rd, Fort Mill, SC 29707, USA
Product Name: Vehicle Mount Computer
Brand Name: Honeywell
Model No.: VM1A-L0N
Model Difference: N/A
Report Number: TERF2212002708ER
FCC ID HD5-VM1AL0N
IC: 1693B-VM1AL0N
Date of EUT Received: December 14, 2022
Date of Test: February 16, 2023 ~ March 03, 2023
Issue Date: March 16, 2023

JJ Chen

Approved By

JJ Chen

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT comply with FCC rule part §15.225, ISED RSS-210.

The results of this report relate only to the sample identified in this report.

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Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
TERF2212002708ER	00	Original.	March 15, 2023	Tiffany Kao	
TERF2212002708ER	01	Revise Date of Test	March 16, 2023	Tiffany Kao	*

Note:

- 1、The remark "*" indicates modification of the report upon requests from certification body.

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Vehicle Mount Computer
Brand Name:	Honeywell
Model No.:	VM1A-L0N
Model Difference:	N/A
Hardware Version:	VM1A-REF MAIN BOARD Rev:2.2
Firmware Version:	85.00.00-1171
EUT Series No.:	2231361919
Power Supply:	15V
Test Software (Name/Version)	NFC_FTM_Tool/1.0

1.2 RF specification

Radio Technology:	NFC
Operating Frequency	13.56MHz
Transmit Power	34.25dBuV/m at 30m.
Number of Channels	1
Modulation Type	ASK
Antenna Type	Loop Antenna

Note: Antenna information is provided by the applicant.

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1.3 Test Methodology

FCC Part 15, Subpart C §15.225
RSS-210 issue 10 December 2019
RSS-Gen, Issue 5 April 2018
ANSI C63.10:2013.

1.4 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1 SAC 2 SAC 3 Conduction 1 Conducted 1 Conducted 2 Conducted 3 Conducted 4 Conducted 5 Conducted 6	TW0027	TW3702
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C SAC C SAC D SAC G Conducted A Conducted B Conducted C Conducted D Conducted E Conducted F Conducted G	TW0028	

Note: Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.

1.5 Special Accessories

There is no other accessory attached. This is the worst case condition.

1.6 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The Transmitter was operated in the normal operating mode. The Tx frequency was fixed which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Radiated Emissions

The EUT is a placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

2.3.3 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*6m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

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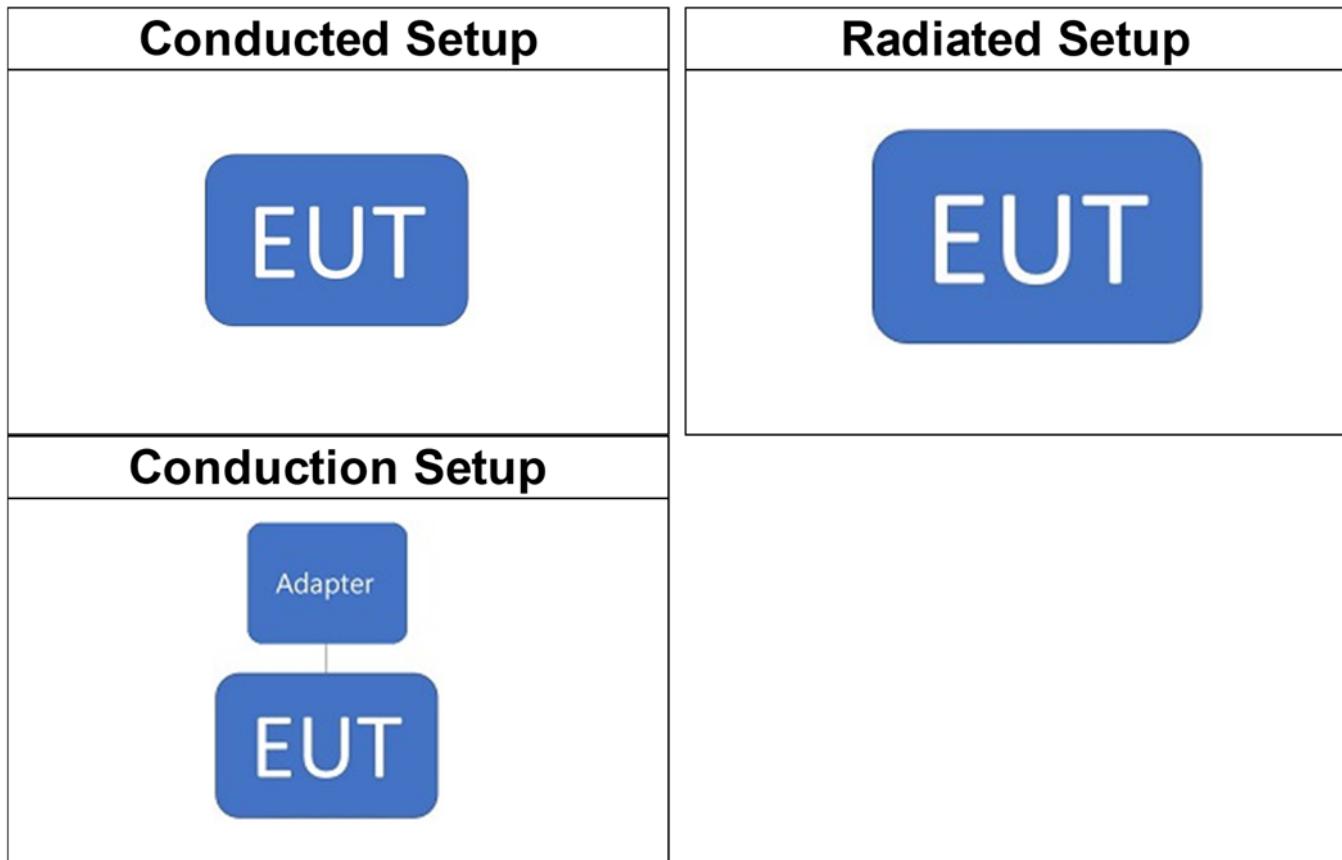
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2.4 Test Configuration



2.5 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Adapter	GlobTek, Inc	GT-46600-6015-T3	N/A	N/A	N/A
Conducted Emission Test Site: Conducted 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
H-Loop Near Field Antenna	EMCI	LF-R 400	02-1637	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.207	RSS-Gen § 8.8	AC Power Line Conducted Emission	Compliant
§15.225 (a)-(d)	RSS210 Annex B B.6 (a)	Radiated Emission	Compliant
§15.209	RSS-Gen § 8.9	Radiated Emission Limits, general requirement	Compliant
§15.225 (e)	RSS210 Annex B B.6 (b)	Frequency Stability	Compliant
§2.1049 §15.215 (c)	RSS-Gen § 6.7	Emission Bandwidth	Compliant
§15.203	N/A	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 The Worst Test Modes and Channel Details

1. The EUT stay in continuous transmission mode.
2. The frequency 13.56 MHz is the default channel to test, where it is the only manipulative channel as this application supports.
3. Only one configuration is supported/applicable as follows.

RADIATED EMISSION TEST			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
NFC	1	1	ASK
FREQUENCY STABILITY			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
NFC	1	1	ASK
20dB BANDWIDTH			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
NFC	1	1	ASK

The field strength of radiated emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty		
AC Power Line Conducted Emission	+/-	2.32	dB
Frequency Stability	+/-	1.53	Hz
Emission Bandwidth	+/-	1.53	Hz
Temperature	+/-	0.7	°C
Humidity	+/-	3	%
DC / AC Power Source	+/-	1	%

Radiated Spurious Emission Measurement Uncertainty		
Polarization: Vertical	+/- 2.8 dB	9kHz~30MHz
	+/- 4.82 dB	30MHz - 1000MHz
	+/- 4.37 dB	1GHz - 18GHz
	+/- 4.21 dB	18GHz - 40GHz
Polarization: Horizontal	+/- 2.8 dB	9kHz~30MHz
	+/- 4.54 dB	30MHz - 1000MHz
	+/- 4.37 dB	1GHz - 18GHz
	+/- 4.21 dB	18GHz - 40GHz

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 MEASUREMENT EQUIPMENT USED

6.1 Emission from AC power line

AC Power-Line Conducted Emission Test Site: Conduction 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI 7	100759	08/22/2022	08/21/2023
LISN	SCHWARZBECK	NSLK 8127	01040	08/23/2022	08/22/2023
Coaxial Cables	EMC Instruments Corp.	EMCCFD300-BM-BM-3000	161207	06/22/2022	06/21/2023
Test Software	audix	e3	Ver. 9 210322	N.C.R	N.C.R

6.2 Conducted Measurement

Conducted Emission Test Site: Conducted 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	KEYSIGHT	N9010B	MY59071571	05/19/2022	05/18/2023
Temperature Chamber	TERCHY	MHG-120LE	1110435	05/27/2022	05/26/2023
DC Block	Mini-Circuits	BLK-18-S+	1	12/13/2022	12/12/2023

6.3 Radiated Measurement

Radiated Emission Test Site: SAC 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Bi-log Antenna	TESEO	CBL 6112D	35242 & AT-N0555	12/27/2022	12/26/2023
Loop Antenna	ETS.LINDGREN	6502	148045	10/05/2022	10/04/2023
Spectrum Analyzer	Agilent	E4446A	MY51100003	10/28/2022	10/27/2023
EMI Test Receiver	R&S	ESCI 7	100759	08/22/2022	08/21/2023
Site Cal	SGS	SAC 1	N/A	01/01/2023	12/31/2023
Pre-Amplifier	HP	8447D	2944A09469	12/13/2022	12/12/2023
Coaxial Cable	Huber Suhner	succoflex 102	MY2622/2	12/13/2022	12/12/2023
Coaxial Cable	Huber Suhner	succoflex 104A	800086/4a	12/13/2022	12/12/2023
Coaxial Cable	Huber Suhner	EMC 104-SM-SM-2000	160123	12/13/2022	12/12/2023
Test Software	Audix	e3	Ver. 9.210322	N.C.R	N.C.R

NOTE: N.C.R refers to Not Calibrated Required.

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7 CONDUCTED EMISSIONS TEST

7.1 Standard Applicable

According to §15.207 and frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

Frequency range MHz	Limits (dBuV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

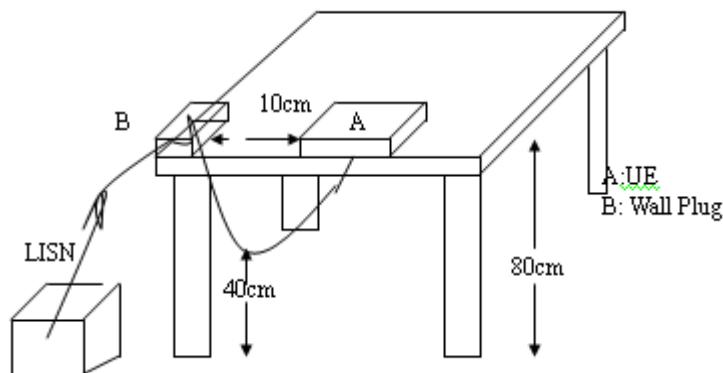
Note

- 1.The lower limit shall apply at the transition frequencies
- 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

7.2 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

7.3 Test SET-UP (Block Diagram of Configuration)



7.4 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

7.5 Measurement Result

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closest to the limit.

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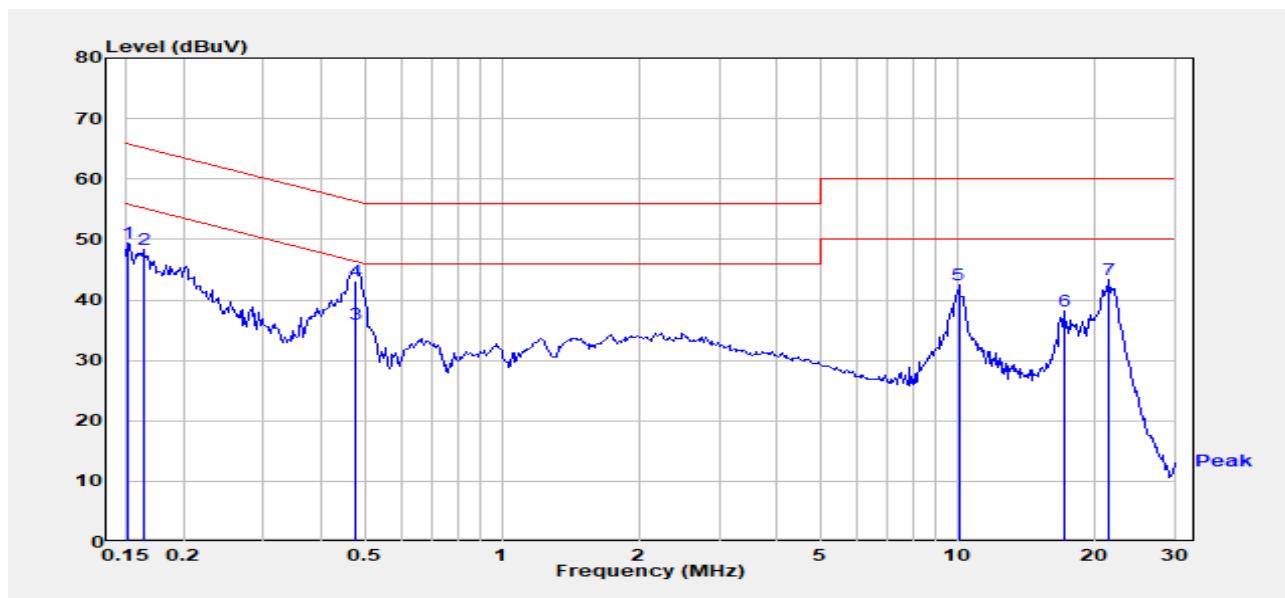
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Cradle (S/N: VM1DG223800172)

Report Number	:TERF2212002708ER	Test Site	:Conduction 1
Test Mode	:NFC	Test Date	:2023-03-03
Power	:120V/60Hz	Temp./Humi.	:23.8/52
Probe	:L	Engineer	:GN Lin



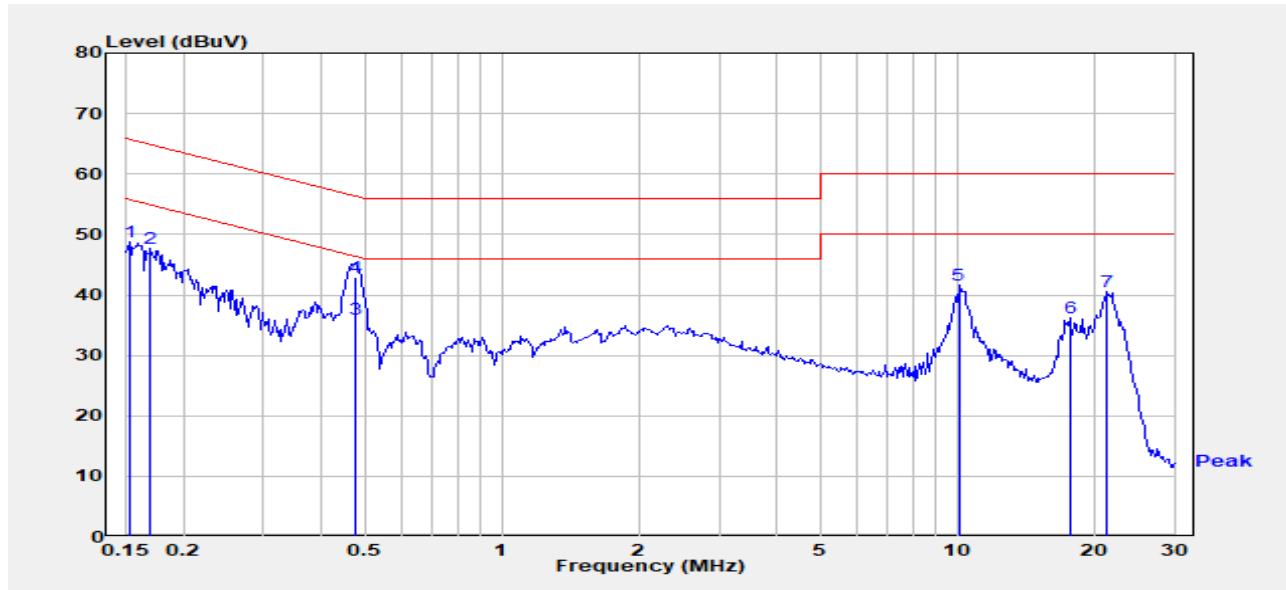
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V	Limit dB μ V	Margin dB
0.151	Peak	49.48	0.05	49.53	65.94	-16.41
0.163	Peak	48.24	0.05	48.29	65.30	-17.01
0.478	Average	35.93	0.05	35.98	46.37	-10.39
0.478	QP	43.08	0.05	43.13	56.37	-13.24
10.083	Peak	42.04	0.34	42.39	60.00	-17.61
17.127	Peak	37.70	0.57	38.26	60.00	-21.74
21.564	Peak	42.64	0.66	43.30	60.00	-16.70

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Report Number :TERF2212002708ER Test Site :Conduction 1
Test Mode :NFC Test Date :2023-03-03
Power :120V/60Hz Temp./Humi. :23.8/52
Probe :N Engineer :GN Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V	Limit dB μ V	Margin dB
0.152	Peak	48.82	0.05	48.87	65.87	-17.00
0.170	Peak	47.54	0.05	47.59	64.98	-17.39
0.478	Average	36.03	0.05	36.08	46.37	-10.29
0.478	QP	42.94	0.05	42.99	56.37	-13.38
10.083	Peak	41.26	0.33	41.59	60.00	-18.41
17.661	Peak	35.64	0.49	36.14	60.00	-23.86
21.399	Peak	39.99	0.54	40.53	60.00	-19.47

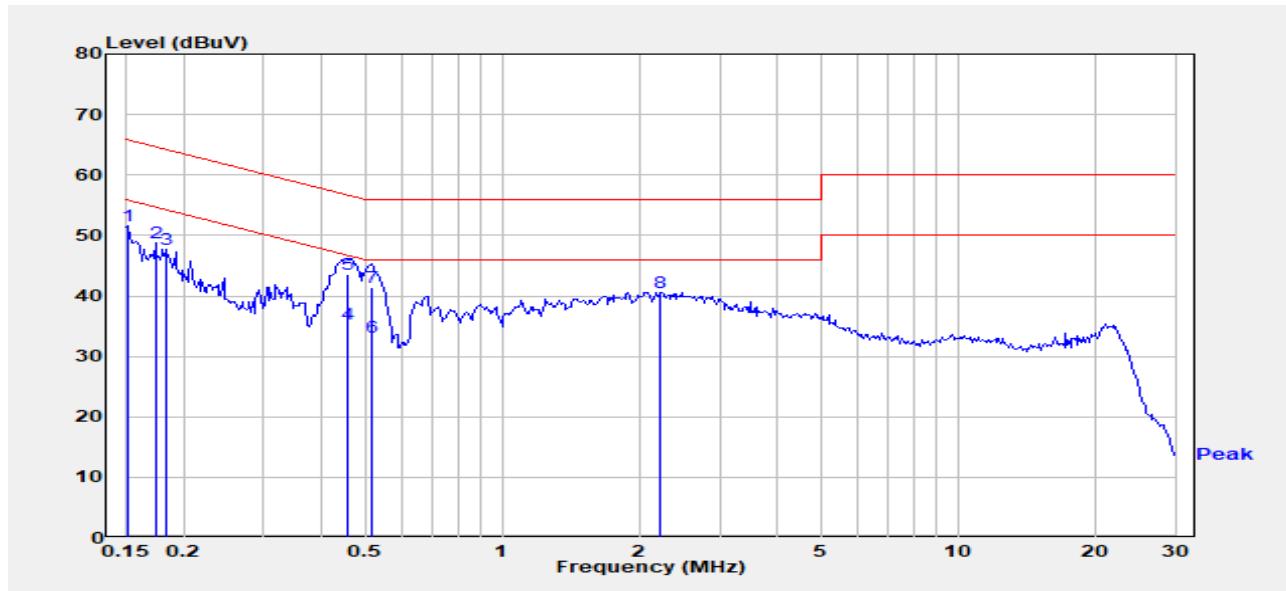
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Cradle (S/N: VM3AC2235G00006)

Report Number :TERF2212002708ER Test Site :Conduction 1
Test Mode :NFC Test Date :2023-03-03
Power :120V/60Hz Temp./Humi. :23.8/52
Probe :L Engineer :GN Lin



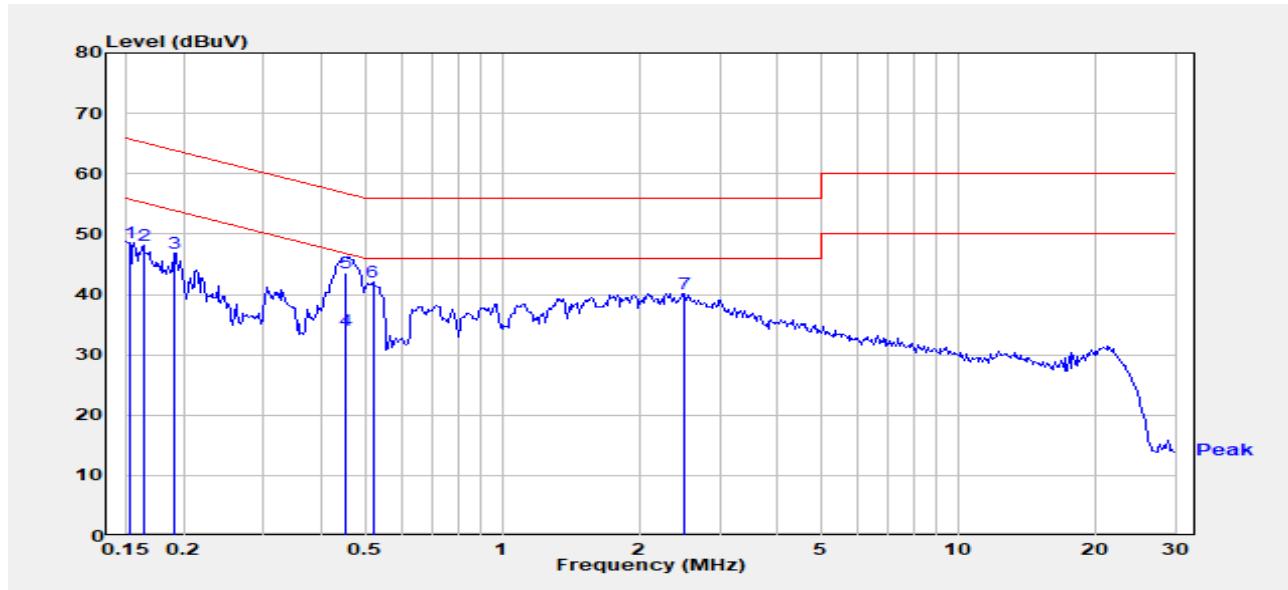
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V	Limit dB μ V	Margin dB
0.151	Peak	51.65	0.05	51.70	65.94	-14.23
0.174	Peak	48.71	0.05	48.76	64.79	-16.03
0.183	Peak	47.65	0.05	47.70	64.34	-16.64
0.457	Average	35.21	0.05	35.26	46.75	-11.49
0.457	QP	43.52	0.05	43.57	56.75	-13.18
0.516	Average	33.16	0.05	33.21	46.00	-12.79
0.516	QP	41.38	0.05	41.43	56.00	-14.57
2.221	Peak	40.50	0.10	40.60	56.00	-15.40

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Report Number :TERF2212002708ER Test Site :Conduction 1
Test Mode :NFC Test Date :2023-03-03
Power :120V/60Hz Temp./Humi. :23.8/52
Probe :N Engineer :GN Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V	Limit dB μ V	Margin dB
0.152	Peak	48.56	0.05	48.61	65.87	-17.26
0.163	Peak	48.13	0.05	48.18	65.30	-17.12
0.190	Peak	46.75	0.05	46.80	64.02	-17.23
0.453	Average	33.94	0.05	33.99	46.82	-12.82
0.453	QP	43.57	0.05	43.62	56.82	-13.19
0.520	Peak	41.93	0.05	41.98	56.00	-14.02
2.512	Peak	39.99	0.12	40.11	56.00	-15.89

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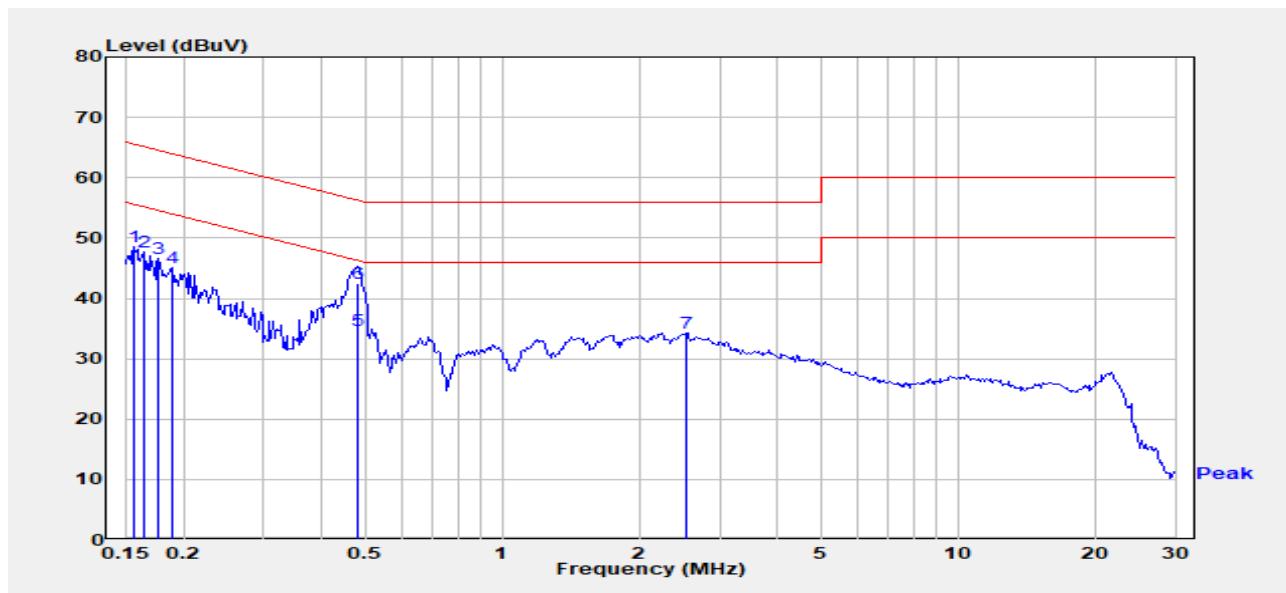
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Cradle (S/N: VW3AC2304G00015)

Report Number	:TERF2212002708ER	Test Site	:Conduction 1
Test Mode	:NFC	Test Date	:2023-03-03
Power	:120V/60Hz	Temp./Humi.	:23.8/52
Probe	:L	Engineer	:GN Lin



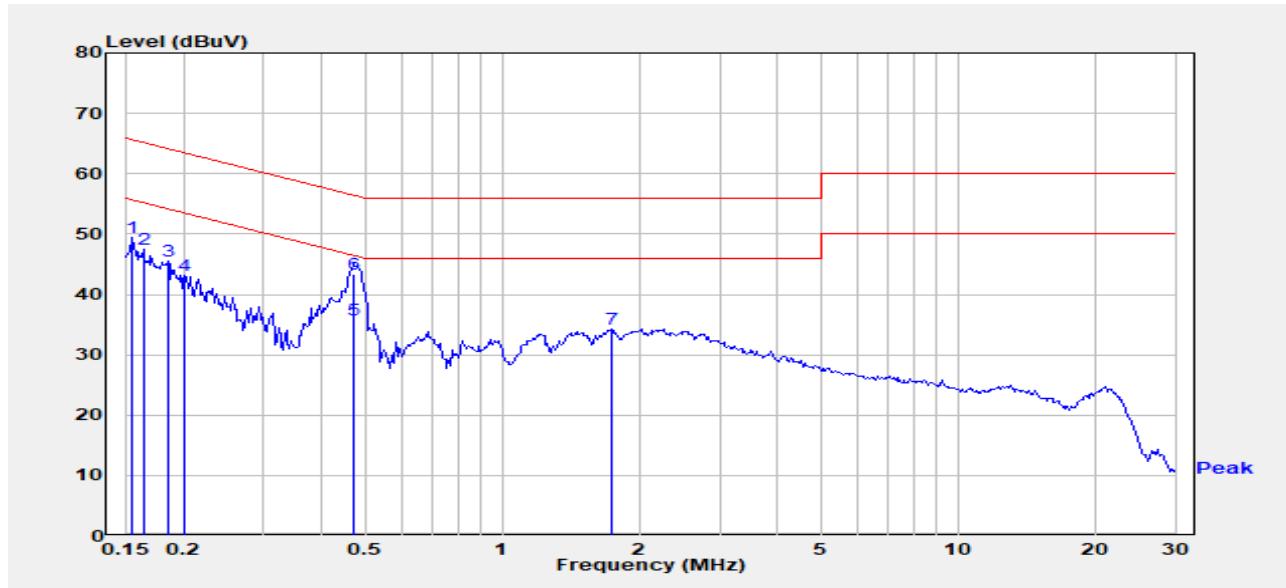
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V	Limit dB μ V	Margin dB
0.156	Peak	48.51	0.05	48.56	65.68	-17.12
0.163	Peak	47.66	0.05	47.71	65.30	-17.59
0.176	Peak	46.63	0.05	46.68	64.66	-17.98
0.189	Peak	44.95	0.05	45.00	64.09	-19.09
0.482	Average	34.68	0.05	34.73	46.31	-11.57
0.482	QP	42.44	0.05	42.49	56.31	-13.81
2.531	Peak	34.20	0.12	34.32	56.00	-21.68

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Report Number :TERF2212002708ER Test Site :Conduction 1
Test Mode :NFC Test Date :2023-03-03
Power :120V/60Hz Temp./Humi. :23.8/52
Probe :N Engineer :GN Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V	Limit dB μ V	Margin dB
0.155	Peak	49.47	0.05	49.52	65.74	-16.22
0.163	Peak	47.37	0.05	47.42	65.30	-17.88
0.185	Peak	45.54	0.05	45.59	64.28	-18.68
0.201	Peak	43.10	0.05	43.15	63.58	-20.43
0.475	Average	35.75	0.05	35.80	46.43	-10.63
0.475	QP	43.23	0.05	43.28	56.43	-13.15
1.737	Peak	34.24	0.08	34.32	56.00	-21.68

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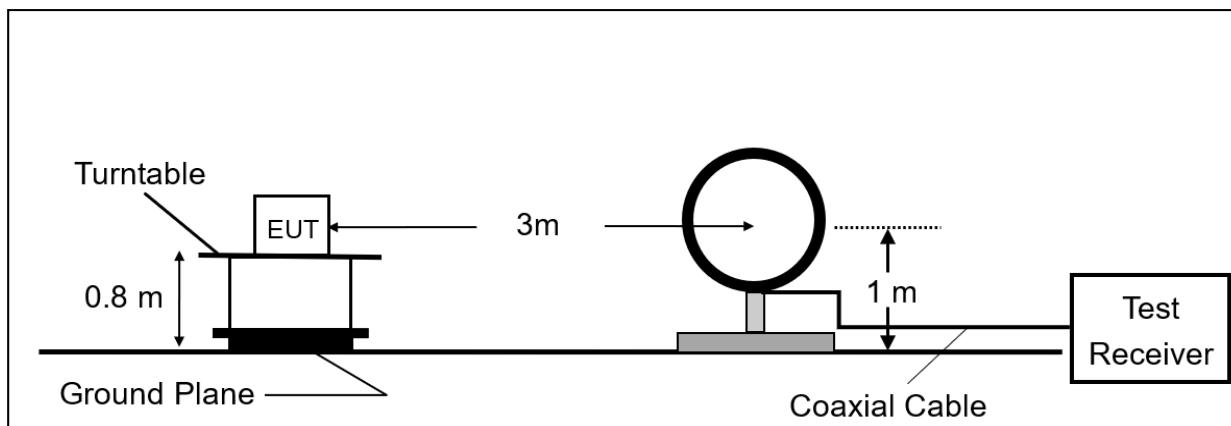
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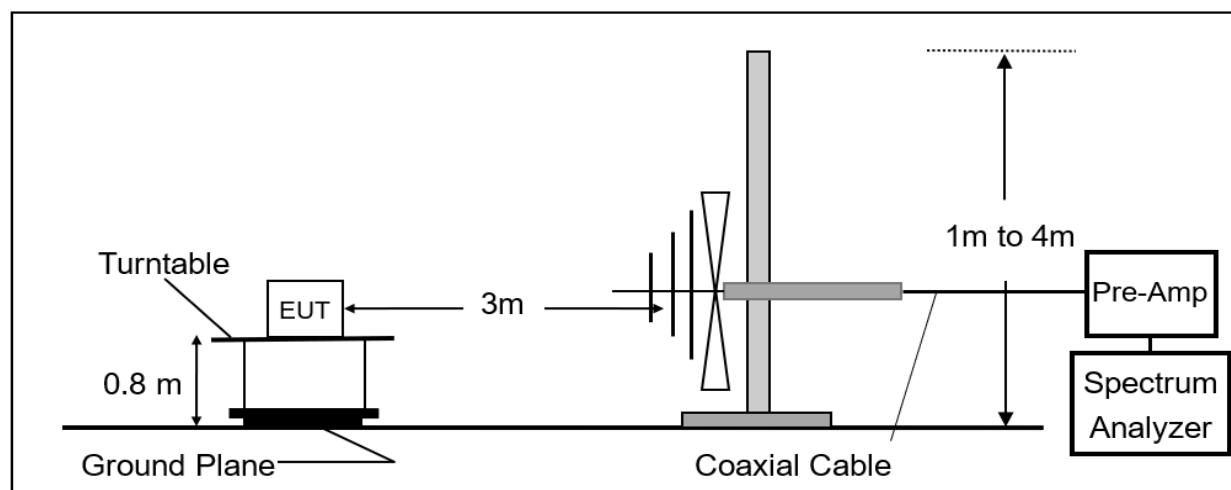
8 RADIATED EMISSION TEST

8.1 Test SET-UP (Block Diagram of Configuration)

(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



8.2 Measurement Procedure

1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plane and been measured in the frequency range between 0.009MHz to 30MHz and 30MHz to 1GHz.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all default test channel measured were complete.

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8.3 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$\mathbf{FS = RA + AF + CL - AG}$$

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

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8.4 Field Strength of Fundamental Emission

8.4.1 Applicable standard

Rules and specifications	CFR 47 Part 15 section 15.225(a)-(d)	
Frequency of Emission (MHz)	Field Strength (μ V/m) at 30m	Field Strength (dB μ V/m) at 30m
1.705~13.110	30	29.5
13.110~13.410	106	40.5
13.410~13.553	334	50.5
13.553~13.567	15848	84
13.567~13.710	334	50.5
13.710~14.010	106	40.5
14.010~30.00	30	29.5

Radiated Mask per ISED RSS 210 Annex B B6

- (a) 15.848 millivolts/m (84 dB μ V/m) at 30 m, within the band 13.553-13.567 MHz.
- (b) 334 microvolts/m (50.5 dB μ V/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz.
- (c) 106 microvolts/m (40.5 dB μ V/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz.
- (d) RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 MHz

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8.4.2 Distance Extrapolation Factor

30m to 3m

Distance extrapolation = $40 * \log (30/3) = 40$ dB

30m to 10m

Distance extrapolation = $40 * \log (30/10) = 19.08$ dB

10m to 3m

Distance extrapolation = $40 * \log (10/3) = 20.92$ dB

Note:

1. Distance extrapolation factor = $40 \log (\text{required distance} / \text{test distance})$ (dB)
2. The lower limit shall apply at the transition frequencies.
3. KDB 414788 D01 OATS and 3m semi-anechoic chamber Justification:
Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. OATS and 3m SAC chamber testing had been performed and 3m SAC measured test result is the worst case test result.

Actual FS(dB μ V/m) = Spectrum. Reading level(dB μ V) + Factor(dB)

Below 30 MHz of Factor(dB) = Antenna Factor(dB μ V/m) + Cable Loss(dB) – Distance Factor (dB)

Above 30 MHz of Factor(dB) = Antenna Factor(dB μ V/m) + Cable Loss(dB) – Pre_Amp Gain (dB)

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

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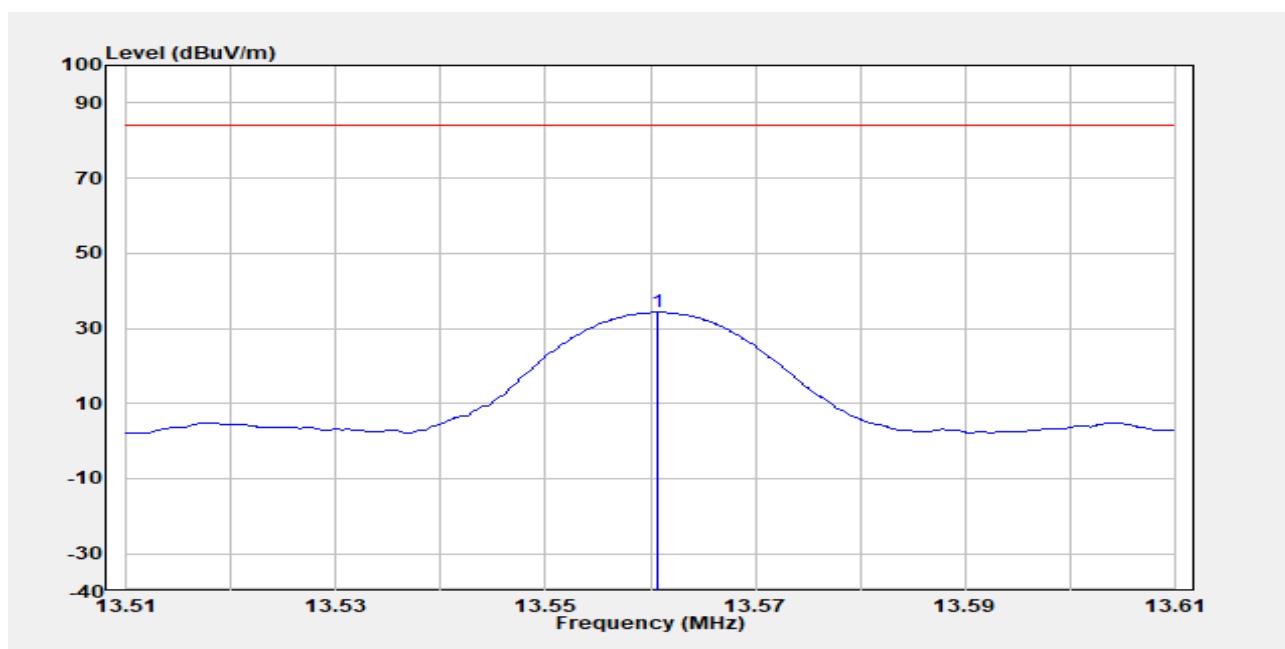
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8.4.3 Field Strength of Fundamental Emission Measurement Result

Report Number	:TERF2212002708ER	Test Site	:SAC 1
Operation Mode	:NFC	Test Date	:2023-02-16
Test Frequency	:13.56 MHz	Temp./Humi.	:23.4/65
Test Mode	:Main	Antenna Pol.	:Horizontal
EUT Pol	:E1 Plane	Engineer	:GN Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit dB μ V/m	Margin dB
13.56	Peak	62.38	-28.14	34.25	84.00	-49.75

Actual level = Reading level + Factor

Factor = Antenna factor + cable loss – Pre_Amplifier Gain – distance factor

Test distance= 3m

For Actual level and limit:

Field strength (dB μ V/m) at 300m,within the band 9 kHz - 490 kHz.

Field strength (dB μ V/m) at 30m,within the band 490 kHz - 30 MHz.

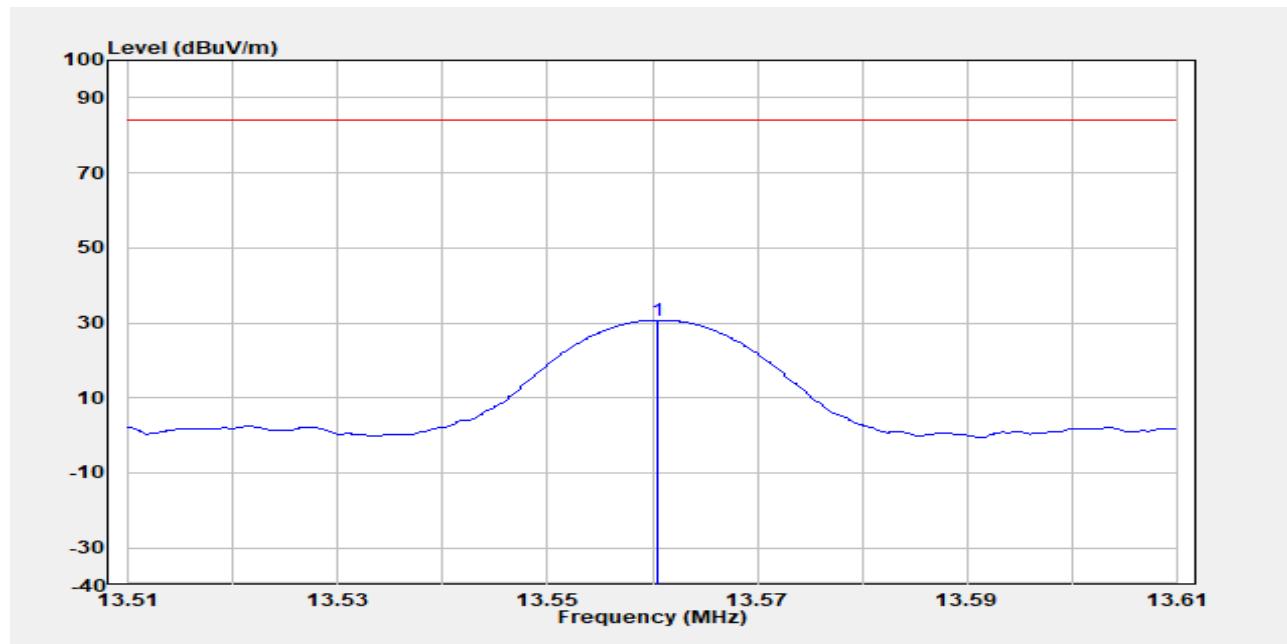
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Report Number :TERF2212002708ER
Operation Mode :NFC
Test Frequency :13.56 MHz
Test Mode :Main
EUT Pol :E1 Plane

Test Site :SAC 1
Test Date :2023-02-16
Temp./Humi. :23.4/65
Antenna Pol. :Vertical
Engineer :GN Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit dB μ V/m	Margin dB
13.56	Peak	58.31	-27.56	30.74	84.00	-53.26

Actual level = Reading level + Factor

Factor = Antenna factor + cable loss – Pre_Amplifier Gain – distance factor

Test distance= 3m

For Actual level and limit:

Field strength (dBuV/m) at 300m,within the band 9 kHz - 490 kHz.

Field strength (dBuV/m) at 30m,within the band 490 kHz - 30 MHz.

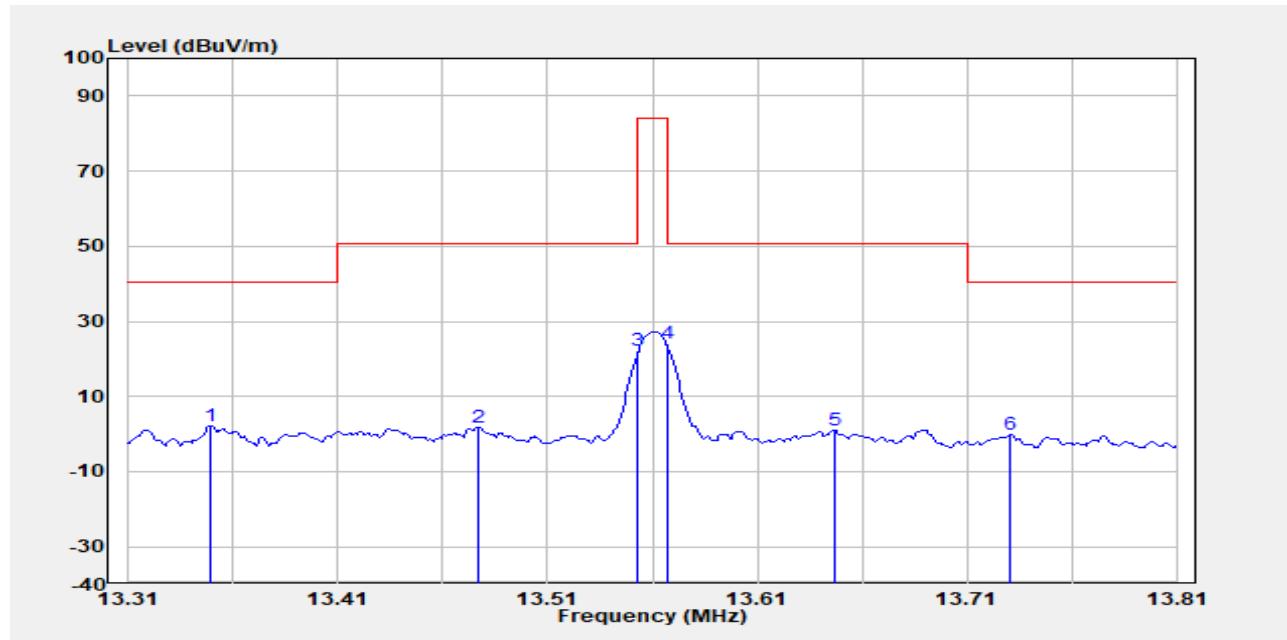
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Report Number :TERF2212002708ER
 Operation Mode :NFC
 Test Frequency :13.56 MHz
 Test Mode :Mask
 EUT Pol :E1 Plane

Test Site :SAC 1
 Test Date :2023-02-16
 Temp./Humi. :23.4/65
 Antenna Pol. :Vertical
 Engineer :GN Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit dB μ V/m	Margin dB
13.35	Peak	30.29	-28.10	2.19	40.50	-38.31
13.48	Peak	29.86	-28.11	1.75	50.50	-48.75
13.55	Peak	50.26	-28.11	22.15	50.50	-28.35
13.57	Peak	52.16	-28.11	24.04	50.50	-26.46
13.65	Peak	29.09	-28.12	0.98	50.50	-49.52
13.73	Peak	27.78	-28.12	-0.34	40.50	-40.84

Actual level = Reading level + Factor

Factor = Antenna factor + cable loss – Pre_Amplifier Gain – distance factor

Test distance= 3m

For Actual level and limit:

Field strength (dB μ V/m) at 300m,within the band 9 kHz - 490 kHz.

Field strength (dB μ V/m) at 30m,within the band 490 kHz - 30 MHz.

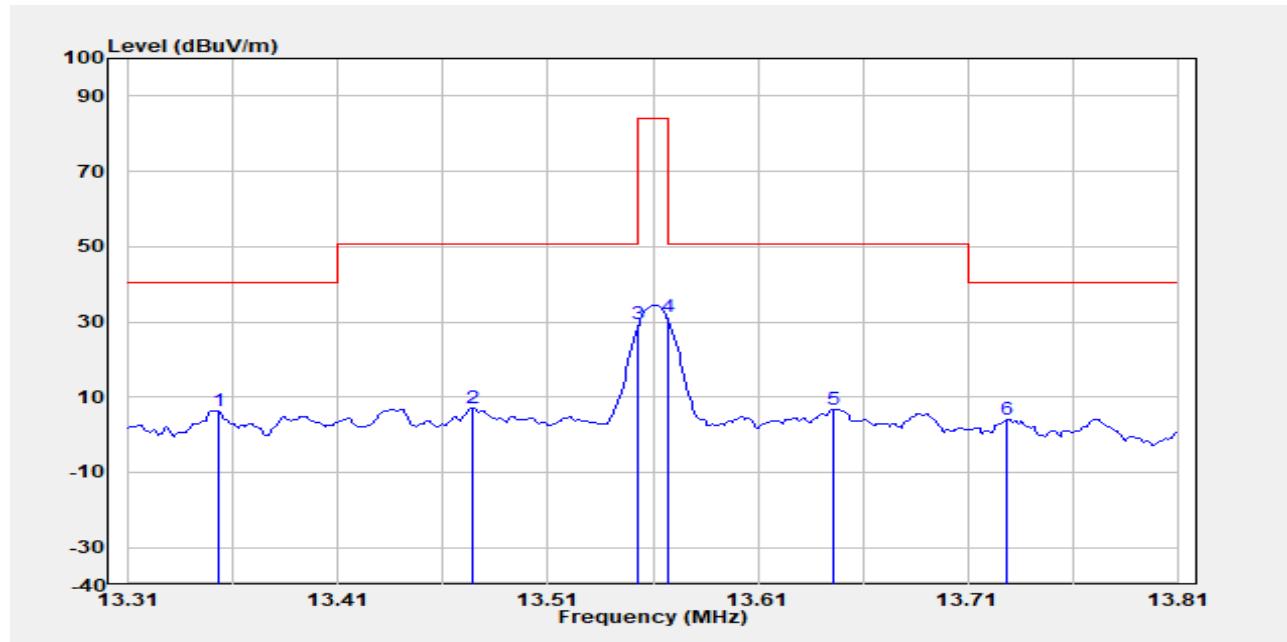
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Report Number :TERF2212002708ER
Operation Mode :NFC
Test Frequency :13.56 MHz
Test Mode :Mask
EUT Pol :E1 Plane

Test Site :SAC 1
Test Date :2023-02-16
Temp./Humi. :23.4/65
Antenna Pol. :Horizontal
Engineer :GN Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit dB μ V/m	Margin dB
13.35	Peak	34.67	-28.20	6.47	40.50	-34.03
13.47	Peak	35.18	-28.21	6.97	50.50	-43.53
13.55	Peak	57.69	-28.21	29.48	50.50	-21.02
13.57	Peak	59.41	-28.21	31.19	50.50	-19.31
13.65	Peak	35.00	-28.22	6.78	50.50	-43.72
13.73	Peak	32.39	-28.22	4.17	40.50	-36.33

Actual level = Reading level + Factor

Factor = Antenna factor + cable loss – Pre_Amplifier Gain – distance factor

Test distance= 3m

For Actual level and limit:

Field strength (dB μ V/m) at 300m,within the band 9 kHz - 490 kHz.

Field strength (dB μ V/m) at 30m,within the band 490 kHz - 30 MHz.

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8.5 Radiated Spurious Emission Measurement

8.5.1 Standard Applicable

The field strength of any emissions appearing outside of the 13.110-14.010 MHz shall not exceed the general radiated emission limits in section 15.209 as below.

Frequency (MHz)	Field strength (μ V/m)	Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

1. Emission level in $\text{dB}\mu\text{V}/\text{m} = 20 \log (\mu\text{V}/\text{m})$
2. Distance extrapolation factor = $40 \log (\text{required distance}/ \text{test distance})$ (dB)
3. $20 \log (30 \mu\text{V}/\text{m}) = 29.54 \text{ dB}\mu\text{V}/\text{m}$
4. The lower limit shall apply at the transition frequencies.
5. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.
6. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of §15.205 and RSS-Gen §8.10.
7. The general radiated emission limits in §15.209 and RSS-Gen §8.9 apply for the spurious emission generate from UE, except for the fundamental emission where the respective section specifies otherwise.

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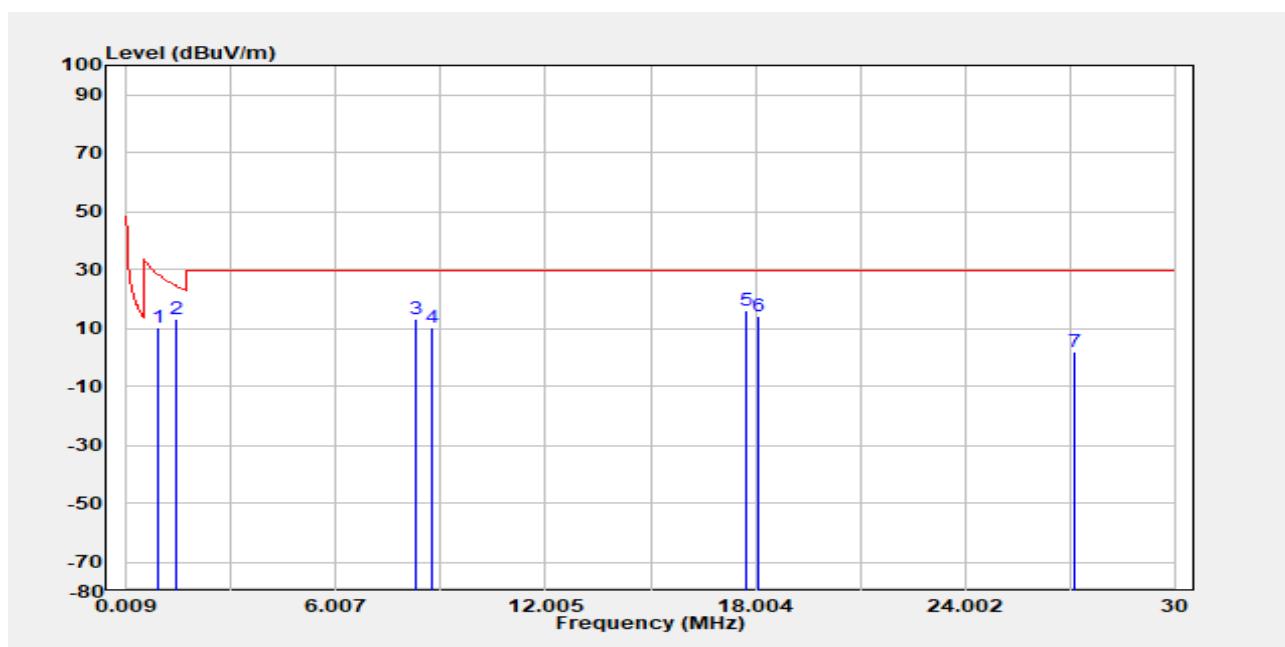
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8.5.2 Radiated Spurious Emission Measurement Result

Report Number	:TERF2212002708ER	Test Site	:SAC 1
Operation Mode	:NFC	Test Date	:2023-02-16
Test Frequency	:13.56 MHz	Temp./Humi.	:23.4/65
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E1 Plane	Engineer	:GN Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit dB μ V/m	Margin dB
0.91	Peak	38.61	-28.49	10.12	28.44	-18.31
1.41	Peak	41.98	-28.60	13.38	24.63	-11.25
8.31	Peak	41.39	-28.10	13.29	29.54	-16.25
8.76	Peak	38.46	-28.02	10.44	29.54	-19.10
17.75	Peak	44.67	-28.37	16.30	29.54	-13.24
18.10	Peak	42.31	-28.39	13.93	29.54	-15.61
27.12	Peak	32.30	-30.19	2.11	29.54	-27.43

Actual level = Reading level + Factor

Factor = Antenna factor + cable loss – Pre_Amplifier Gain – distance factor

Test distance= 3m

For Actual level and limit:

Field strength (dB μ V/m) at 300m,within the band 9 kHz - 490 kHz.

Field strength (dB μ V/m) at 30m,within the band 490 kHz - 30 MHz.

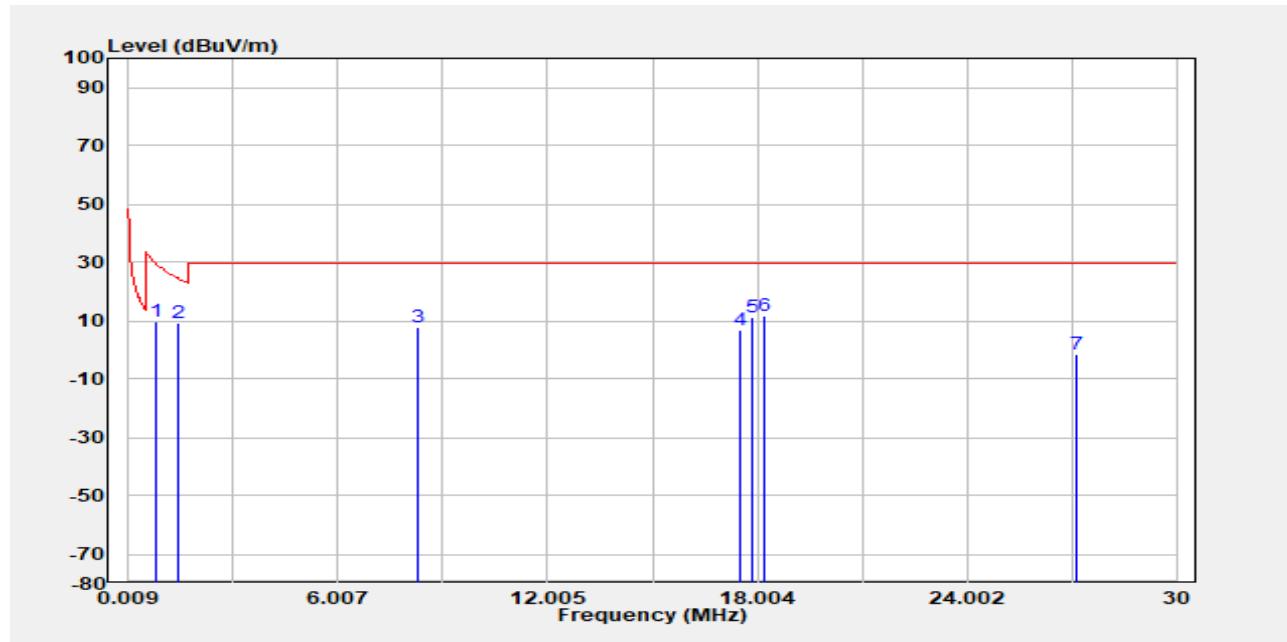
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Report Number :TERF2212002708ER
 Operation Mode :NFC
 Test Frequency :13.56 MHz
 Test Mode :Tx
 EUT Pol :E1 Plane

Test Site :SAC 1
 Test Date :2023-02-16
 Temp./Humi. :23.4/65
 Antenna Pol. :Horizontal
 Engineer :GN Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit dB μ V/m	Margin dB
0.81	Peak	38.19	-28.51	9.67	29.45	-19.78
1.41	Peak	38.07	-28.60	9.47	24.63	-15.16
8.31	Peak	35.68	-28.10	7.58	29.54	-21.96
17.50	Peak	35.33	-28.35	6.98	29.54	-22.56
17.85	Peak	39.56	-28.37	11.19	29.54	-18.35
18.20	Peak	40.34	-28.39	11.95	29.54	-17.59
27.12	Peak	28.64	-30.19	-1.55	29.54	-31.09

Actual level = Reading level + Factor

Factor = Antenna factor + cable loss – Pre_Amplifier Gain – distance factor

Test distance= 3m

For Actual level and limit:

Field strength (dB μ V/m) at 300m,within the band 9 kHz - 490 kHz.

Field strength (dB μ V/m) at 30m,within the band 490 kHz - 30 MHz.

Report Number :TERF2212002708ER

Test Site :SAC 1

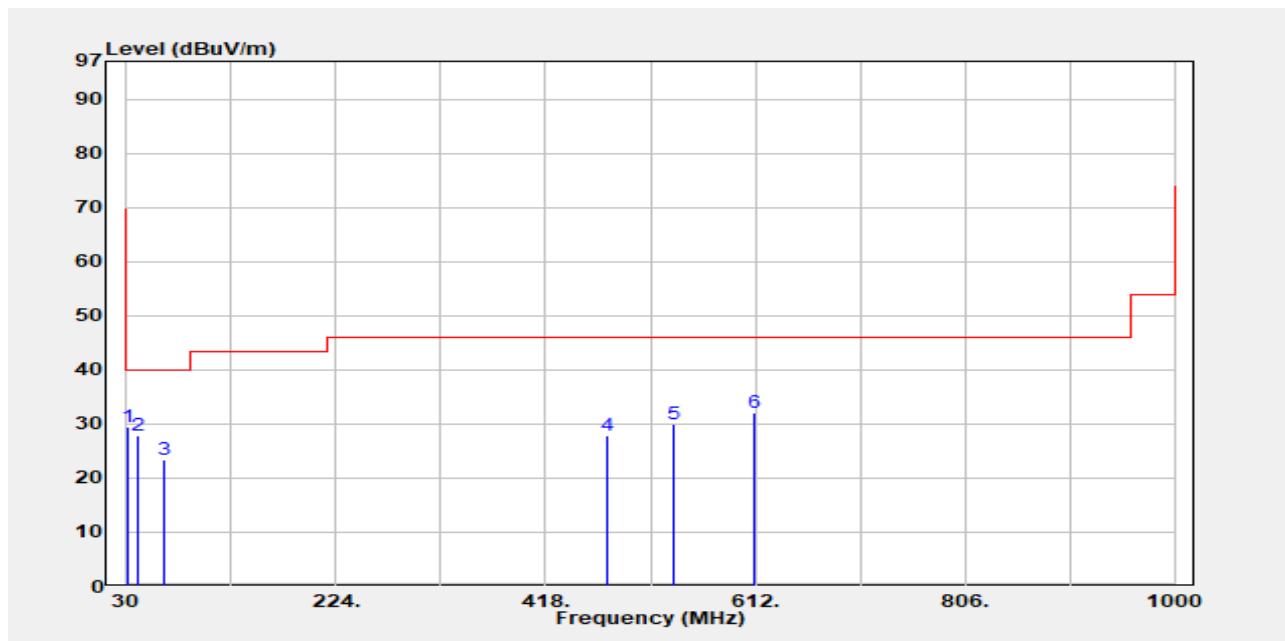
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Operation Mode :NFC
Test Frequency :13.56 MHz
Test Mode :Tx
EUT Pol :E1 Plane

Test Date :2023-02-16
Temp./Humi. :23.4/65
Antenna Pol. :Vertical
Engineer :GN Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit dB μ V/m	Margin dB
31.62	Peak	35.38	-6.01	29.37	40.00	-10.63
41.32	Peak	38.83	-11.08	27.74	40.00	-12.26
63.95	Peak	41.34	-17.96	23.38	40.00	-16.62
474.58	Peak	33.97	-6.03	27.93	46.00	-18.07
536.02	Peak	34.28	-4.19	30.09	46.00	-15.91
610.38	Peak	36.28	-4.30	31.98	46.00	-14.02

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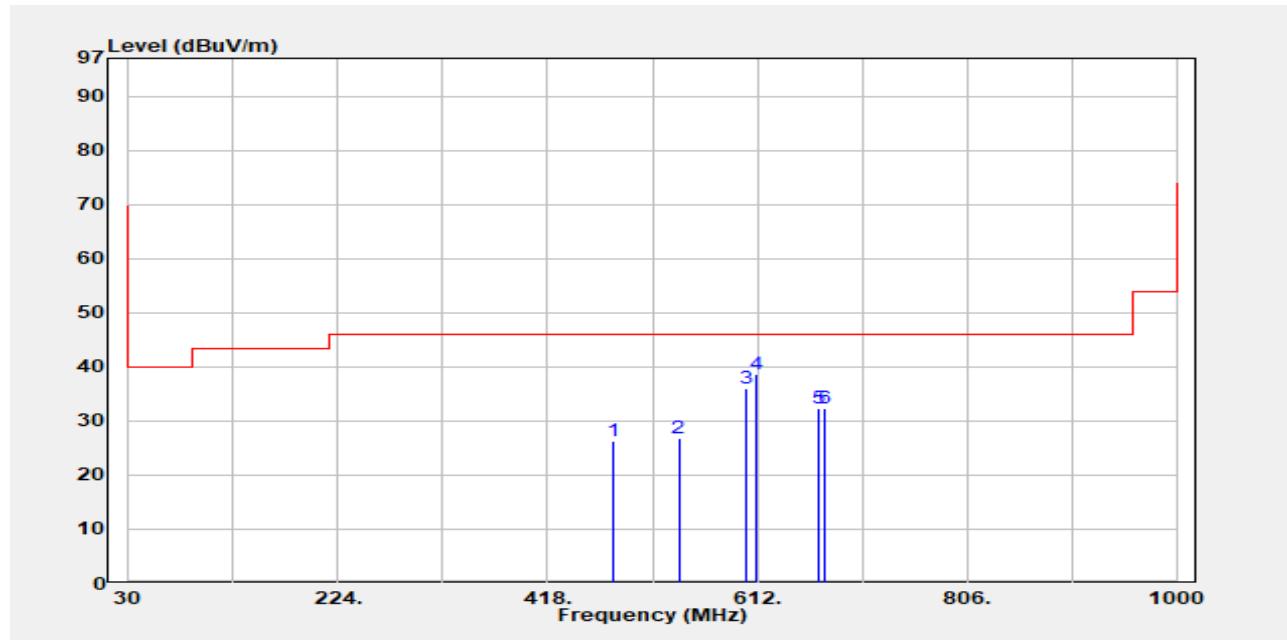
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Report Number :TERF2212002708ER
Operation Mode :NFC
Test Frequency :13.56 MHz
Test Mode :Tx
EUT Pol :E1 Plane

Test Site :SAC 1
Test Date :2023-02-16
Temp./Humi. :23.4/65
Antenna Pol. :Horizontal
Engineer :GN Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit dB μ V/m	Margin dB
479.43	Peak	32.37	-5.95	26.41	46.00	-19.59
539.25	Peak	30.55	-3.81	26.74	46.00	-19.26
602.30	Peak	40.81	-4.73	36.07	46.00	-9.93
610.38	Peak	43.04	-4.30	38.74	46.00	-7.26
668.58	Peak	35.56	-3.32	32.25	46.00	-13.75
675.05	Peak	35.55	-3.14	32.41	46.00	-13.59

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9 FREQUENCY STABILITY

9.1 Applicable Standard

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

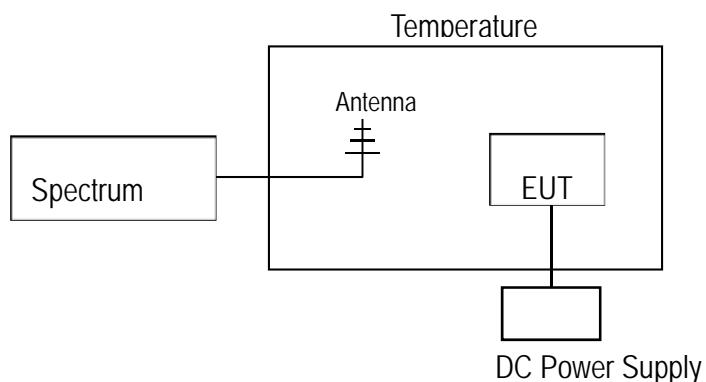
Carrier frequency stability shall be maintained to $\pm 0.01\%$ (± 100 ppm).

For licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of -20°C (-4°F), +20°C (+68°F) and +50°C (+122°F).

9.2 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 10kHz, Span =100kHz.
4. Set SPA Max hold. Mark peak.

9.3 Test SET-UP (Block Diagram of Configuration)



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9.4 Measurement Results

Startup

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
15	-20	13.5600042	0.00420	+/- 1.356
15	-10	13.559997	-0.00300	+/- 1.356
15	0	13.5599969	-0.00310	+/- 1.356
15	10	13.5599913	-0.00870	+/- 1.356
15	20	13.5599928	-0.00720	+/- 1.356
15	30	13.5600072	0.00720	+/- 1.356
15	40	13.5599933	-0.00670	+/- 1.356
15	50	13.5600011	0.00110	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
17.25	20	13.5600018	0.00180	+/- 1.356
15	20	13.5599928	-0.00720	+/- 1.356
12.75	20	13.5600053	0.00530	+/- 1.356

2 minutes

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
15	-20	13.560008	0.00800	+/- 1.356
15	-10	13.5600076	0.00760	+/- 1.356
15	0	13.5600095	0.00950	+/- 1.356
15	10	13.560007	0.00700	+/- 1.356
15	20	13.5599979	-0.00210	+/- 1.356
15	30	13.5600018	0.00180	+/- 1.356
15	40	13.5599985	-0.00150	+/- 1.356
15	50	13.5599909	-0.00910	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
17.25	20	13.5599916	-0.00840	+/- 1.356
15	20	13.5599979	-0.00210	+/- 1.356
12.75	20	13.5599935	-0.00650	+/- 1.356

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5 minutes

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
15	-20	13.5599997	-0.00030	+/- 1.356
15	-10	13.5600062	0.00620	+/- 1.356
15	0	13.5599913	-0.00870	+/- 1.356
15	10	13.5600001	0.00100	+/- 1.356
15	20	13.5599902	-0.00980	+/- 1.356
15	30	13.5599915	-0.00850	+/- 1.356
15	40	13.5600078	0.00780	+/- 1.356
15	50	13.5599961	-0.00390	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
17.25	20	13.5600031	0.00310	+/- 1.356
15	20	13.5599902	-0.00980	+/- 1.356
12.75	20	13.5600042	0.00420	+/- 1.356

10 minutes

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
15	-20	13.5599946	-0.00540	+/- 1.356
15	-10	13.5600064	0.00640	+/- 1.356
15	0	13.5599903	-0.00970	+/- 1.356
15	10	13.5600032	0.00320	+/- 1.356
15	20	13.5600009	0.00090	+/- 1.356
15	30	13.5600046	0.00460	+/- 1.356
15	40	13.5599987	-0.00130	+/- 1.356
15	50	13.5600027	0.00270	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
17.25	20	13.5599904	-0.00960	+/- 1.356
15	20	13.5600009	0.00090	+/- 1.356
12.75	20	13.5599938	-0.00620	+/- 1.356

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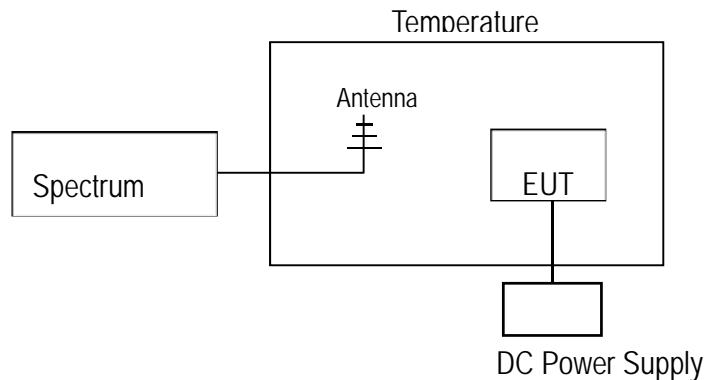
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10 EMISSION BANDWIDTH MEASUREMENT

10.1 Applicable Standard:

The 20 dB and 99% bandwidth shall be specified in operating frequency band.

10.2 Test Set-up



10.3 Measurement Procedure

1. Placed the EUT on the testing table.
2. Set the EUT under transmission condition continuously at specific channel frequency.
3. The resolution bandwidth of 1 kHz and the video bandwidth of 3 kHz were used
4. Measured the spectrum width with power higher than 20dB below carrier.

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10.4 Measurement Result

20dB BW (kHz)
2.708

Operation range	Frequency (MHz)	Limit (MHz)
Low	13.559150	>13.11
High	13.561600	<14.01

99% BW (kHz)
2.322

Bandwidth



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Operation range low



Operation range High



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11 ANTENNA REQUIREMENT

11.1 Standard Applicable:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

11.2 Antenna Connected Construction:

The antenna complies with this requirement and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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